

## CHAPTER 11

## Monitors

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**NOTE to REVIEWERS:** This is a very early draft version, and no effort has been made to reconcile changes in cross references to other chapters in the guide. Please look for comments such as this in the draft, which encourage your feedback on specific issues.

**Please submit comments using the form on <http://www.pcdesguide.org> or by sending e-mail to [comments@pcdesguide.org](mailto:comments@pcdesguide.org).**

**IMPORTANT:** The requirements defined in this guide provide guidelines for designing PC systems that will result in an optimal user experience with typical Windows-based applications running under either the Microsoft Windows98 "Millennium" or later or Windows2000 Professional or later operating systems. These design guidelines are not the basic system requirements for running any version of Windows operating systems.

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The digital revolution is finally extended to the display device. The Digital Visual Interface (DVI) specification provided by the Digital Display Working Group is the industry standard that allows displays to confidentially implement the digital interface. The large legacy of analog VGA monitors can still be fully supported by systems compliant that meet the guidelines in this system design guide. In an effort to comprehend the dawning of the digital age of monitors, this section is divided into three subsections:

- ?? Requirements common for all monitors types.
- ?? Requirements specific to digital monitors.
- ?? Requirements specific to analog monitors.

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## Monitor Basic Features

This section summarizes the basic design requirements common to all monitor types.

**Note:** Dot-pitch requirements are not specified in these guidelines because dot pitch depends on resolution and size. Also, design features other than dot pitch contribute to usability for PC applications, such as focus and phosphor. Monitors should be designed to provide a sharp and clear image across the full range of resolutions they are intended to support.

### [16.1] Color monitor is DDC2B-compliant with unique EDID identifier

A monitor designed for or included with a PC 2001 system must be compliant with Display Data Channel Standard, Version 3.0, Level 2B protocols (DDC2B) which defines the communications channel between the display and host system. A monitor must assume multiple I2C compliant devices exist on the communications bus, and as such, a monitor must not impede the use of the I2C bus in any way. A monitor designed for, or included with, a PC 2001 system ~~is not allowed~~must not issue DDC1 transactions.

**Note to Reviewers:** In the 0.5 version of this guide, this requirement will reflect the new E-DDC and E-EDID specifications from VESA. E-DDC will be required, but pointer addressing may not be required. E-EDID will be required, probably disallowing EDID 2.0 at address A2.

The monitor also must transmit an Extended Display Identification Data (EDID) structure containing unique ID Manufacturer Name and ID Product Code identifiers, plus all required fields, as defined in Section 3 of *Extended Display Identification Data Standard, Version 3.0* or later. The monitor must transmit a EDID 1.3 compliant data structure.

#### Mobile PC Note

Mobile systems are not required to support DDC monitor detection of the display if the display is permanently attached and connected using an internal interface. However, such systems must support DDC for the external monitor interface port.

### [16.2] Monitor supports Integrated Color Management

Systems running Windows 98 and Windows 2000 operating systems must use color profiles that comply with the International Color Consortium (ICC) Profile Format specification. The Integrated Color Management (ICM) APIs and functionality for Windows 98 and Windows 2000 are described in the Microsoft Platform SDK and the Windows 2000 DDK.

#### Mobile PC Note

Color-capable devices such as desktop CRT monitors, LCDs on mobile systems, color plasma and other flat-panel devices, printers, scanners, or still-image

cameras are required to install one or more ICC profiles for ICC color management. A monitor color-calibration utility is ~~recommended~~encouraged for generating, editing, and installing ICC profiles. The standard RGB (sRGB) profile will be distributed in Windows 98 and Windows 2000. ICC profiles are not required for notebook computers with DSTN panels.

### [16.3] Monitor meets all PC 2001 general device and driver requirements

This guideline includes the basic requirements for Plug and Play device IDs, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors. For more information, see “PC 2001 General Device Requirements” in Chapter [X], “PC 2001 Basic Requirements.”

The manufacturer does not need to supply a driver if a PC 2001-compliant driver provided with the operating system can be used. If the manufacturer supplies a driver, it must comply with requirement X.X, “Device driver and installation meet PC 2001 requirements.” The requirements include driver support for unattended installation and Help file support if special driver parameters are used.

**Note:** Monitor support for Windows is installed using a monitor INF file, as defined in the Windows 98 DDK and Windows 2000 DDK.

### ~~[16.4] [DELETE] CRT-based monitor supports a mechanism for control from host software~~

**Note to Reviewers: Recommendations are not included in PC 2001.**

### [16.5] Monitor meets minimum graphics resolution, based on monitor size

With the following higher resolutions, a larger desktop area can be displayed, more applications can be shown on the display at once, individual windows can be larger, applications can be fully displayed side by side, and so on:

- ?? 14-inch to 15-inch external monitor or built-in mobile PC display = 800 × 600, non-interlaced
- ?? 17-inch external monitor or 13-inch to 15-inch external LCD = 1024 × 768, non-interlaced
- ?? 19-inch and larger monitors or LCDs larger than 15 inches = 1280 × 1024, non-interlaced

~~**Note:** These specific monitor sizes are not listed as recommended or required; they merely show the required resolution for a given size.~~

### ~~[16.7] CRT-based m~~Monitor synchronizes to a new format in ~~a timely fashion~~less than three seconds

When the scanning rate into the monitor is changed from one of its valid rates to another valid rate, the monitor must resynchronize to the new format and

produce a stable picture within three seconds from the graphics adapter becoming stable.

This capability is important because sometimes a change from a high refresh-rate graphics mode to a 60-Hz (or 59.94 variant) mode is necessary to optimize video playback.

**Note:** The monitor should be designed to minimize the noise emitted as it transitions between rates because this noise can be alarming to some users.

#### [16.12] External monitor meets DDC2B and EDID standards

**Note to Reviewers:** This requirement will be updated in v0.5 to reflect changes in requirement [16.1] regarding the new VESA specifications for E-DDC and E-EDID.

This requirement is based on DDC2B, which defines the communications channel between the display and host system, and on EDID Version 3.0, which defines data formats for configuration information. This requirement includes the identification string and other EDID data that the monitor sends to the system.

Use the established standard or (if necessary) detailed timings to indicate the maximum resolution that the monitor ~~will support~~supports. Using either the established or the standard timings ~~will result~~results in greater flexibility when using detailed timing descriptor blocks.

The following items are particularly critical:

?? EDID content must indicate the complete range of the monitor's capabilities.

Do not use the EDID to indicate only the preset modes that the monitor supports. Take advantage of the established and standard timings to include as much information about the monitor's capabilities as possible.

?? At least one piece of information must indicate the maximum resolution plus maximum timing at that resolution supported by the monitor. If this indication is not implemented using the established or standards timings, ~~then~~ a detailed timing can be used.

To enhance the Plug and Play functionality of monitors, the following monitor descriptor definitions are strongly recommended, as defined in the VESA EDID standard:

?? **FD (monitor range).** This information is essential for enabling the operating system to calculate the optimal refresh rate for any selected resolution.

?? **FC (monitor name).** Up to three detailed timing blocks can be used to incorporate the company and model name. These descriptors ~~will~~must be concatenated for a single string, and the blocks must be used in the order in which they are to be concatenated.

?? **FF (monitor serial number).** If provided, this information ~~will be~~ placed into the registry for easy access by asset-management software.

**[NEW] Monitors must support Text Mode 3, 640x480 and 640x400**

During system boot and in the event of an error, Windows 98 and Windows 2000 use lower resolution scanning formats such as 640 × 480, 640 × 400, and “text mode 3.” The monitor must be able to display these important screens. It can be confirmed that a monitor that complies with this requirement by booting a PC and ensuring that the monitor is able to sync to all the screens displayed during the boot sequence.

## Large Format Monitor Requirements

Large format ~~monitors are defined as monitors~~ monitors are larger than 25 inches, measured diagonally. These monitors typically require a picture tube ideal for both PC graphics and television/movie video. This section defines the requirements for large format entertainment monitors. The large format monitors are required to meet all requirements common to all monitors.

**[16.9] Large Format CRT-based monitor supports 800 × 600 at 60 Hz refresh rate**

Recommended refresh rate: 60 Hz (and 59.94 variant) for North America. Various rates are appropriate for Europe, such as 50, 60, or 75 Hz, depending on the video processing capabilities of the host PC.

~~It is acceptable to use~~ In North America, using 60 Hz (or the 59.94 variant) ~~in North America is acceptable~~ because these types of monitor are intended to be viewed from at least a 6-foot distance, thus avoiding excessive flicker. Keeping the rate the same as the native video source ~~will result~~ results in the best video quality because of the judder problems associated with using linear video processing to change refresh rates.

A display format of 800 × 600 at 60 Hz progressive (or the wide-screen equivalent) requires a refresh rate of about 38 kHz. This rate is commonly available in CRT-based large-screen TV-style monitors. A display format of 1024 × 768 at 60 Hz progressive (or the wide-screen equivalent) is preferable, but requires a scan rate of around 47 kHz. With the advent of good scaling ~~on graphics adapters~~ and program-enhancing additional data services, good use can be made of the higher resolution if it is available.

This requirement does not mean to imply the large format monitor needs to use CRT technology. The use of flat-panel alternatives is encouraged. The resolution and size, but not timing, requirements are the same as for CRT devices.

**[16.11] If a large Format monitor's implements host control ~~has digitally-controlled geometry~~ the software mechanism meets USB or VESA standard**

The control of brightness, contrast, screen offset, and so on, should be controllable from host software. The mechanism for software control of monitor functionality must be either USB or the VESA DDC/CI standard.

Other controls, such as picture offset, are important since the system needs to switch between desktop refresh rates, such as 75 Hz, and video refresh rates, such as 60 Hz, to optimize video playback. Software control is also important in remote control applications such as IR/RF remote.

Geometry control is necessary for adjustment of PC television images and includes the following controls: skew, pin cushion, size, brightness, contrast, and position. Geometry control must be provided through a software application rather than through dials on the monitor case. Controls must be revealed through a driver with a remote-controllable user interface.

## Digital Monitor Features

This section summarizes the specific requirements for Digital monitors.

**[NEW] Digital display interface must be DVI compliant**

The DVI interface is now the industry standard interface for digital display device interconnect interface. Any system implementing a digital monitor output capability must implement DVI-compliant port. Any monitor or display device accepting a digital input for display data must implement a DVI-compliant port.

**[NEW] Digital monitor must enter a sub-1 watt power state when +5 volt signal transitions to zero**

Digital monitor must enter a sub-1 watt power state when +5 volt signal in the DVI connector transitions to zero. The DVI specification enables monitors to be aggressively power managed. The transition of the +5 volts signal associated with DDC in the DVI connector indicates to the monitor either that the system has been turned off or that the system is not planning on using the monitor for an extended period of time. In either case, the monitor must enter an extremely low power state.

**[NEW] Digital Monitors support Hot Plug Detection**

The DVI-compliant monitor must provide a +5 volt signal to the system within 250mS of the system's assertion of the +5 volt DDC signal to indicate that the monitor is present and capable of transmitting EDID data. The DVI-compliant monitor is required to provide the +5 volt Hot Plug Detection Signal to the system as long as the system is providing the +5 volt DDC signal to the monitor.

## Analog Monitor Features

This section summarizes the specific requirements for Analog monitors.

### [16.6] CRT-based monitor supports ergonomic timing standards

The monitor must, at a minimum, support the timings documented in *VESA and Industry Standards and Guidelines for Computer Display Monitor Timing Version 1.0, Revision 0.7* or later, for all resolutions supported by the monitor, as based on monitor size, as cited earlier in this section. The standards ensure a clear, flicker-free display for traditional PC computing.

~~It is~~ Also ~~a requirement that~~ monitors ~~are~~must be able to operate with the 59.94 variant of the 60-Hz VESA timing. All references to 60-Hz timing in this chapter should be ~~taken to also indicate~~understood as indicating the 59.94 variant.

### [16.13] ~~Analog M~~monitor complies with device class power management reference specification

The Display Device Class Power Management Reference Specification, Version 1.0 (<http://www.microsoft.com/hwdev/specs/PMref/PMdisplay.htm>) or later, provides definitions of the OnNow device power states (D0–D3) for graphics adapters and monitors. The specification also covers device functionality expected in each power state and the possible wake-up event definitions for the class, if any. CRT monitors must support the D0, D2, and D3 power states. The D1 power state is optional for monitors.

*Digital Monitor Note*

~~Digital displays for mobile and desktop applications can implement just two power states: on and off.~~

**Note to Reviewers: Digital power management is addressed in “Digital Monitor Features.”**

## Checklist for Monitors

- [16.1] *Color monitor is DDC2B-compliant with unique EDID identifier*
- [16.2] *Monitor supports Integrated Color Management*
- [16.3] *Monitor meets all PC 2001 general device and driver requirements*
- [16.5] *Monitor meets minimum graphics resolution, based on monitor size*
- [16.7] *Monitor synchronizes to a new format in less than three seconds*
- [16.12] *External monitor meets DDC2B and EDID standards*
- [NEW] *Monitors must support Text Mode 3, 640x480 and 640x400*
- [16.9] *Large Format CRT-based monitor supports 800 × 600 at 60 Hz refresh rate*
- [16.11] *If a large Format monitor implements host control the software mechanism meets USB or VESA standard*
- [NEW] *Digital display interface must be DVI compliant*
- [NEW] *Digital monitor must enter a sub-1 watt power state when +5 volt signal transitions to zero*
- [NEW] *Digital Monitors support Hot Plug Detection*
- [16.6] *CRT-based monitor supports ergonomic timing standards*
- [16.13] *Analog monitor complies with device class power management reference specification*